TELEMATIC SCHOOLS PROJECT

2023 SUBJECT WORKBOOK
Grade 11

$a+b=c$ MATHEMATICAL LITERACY

A joint initiative between the Western Cape Education Department and Stellenbosch University.

Western Cape Government
Education
FOR YOU

Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

BROADCAST SESSIONS

GRADE 11 Conversions

GRADE 11 Finance

Session	Date	Time	Topic
1	13/02/2023	15h00-16h00	Conversions
2	16/08/2023	16h00-17h00	Finance - interest

INTRODUCTION AND TOPICS

CONVERSIONS

The two main measurement systems:

The most common measurement system used in today is the metric system. The metric system is easy to figure out and to use in calculations. The imperial system, however, is still quite often used, so it is useful to know how it relates to the metric system and hoe to convert between the two systems.

FINANCE

Perform calculations involving interest through manual calculations and without the use of formulae (simple and compound interest).

Topics	Description
CONVERSIONS	• Convert units of length, capacity, mass and time • Convert between SI units (International System/metric system) and imperial units • Measure time in second, minutes, hours, days, weeks and months • Convert between degrees Celsius to Fahrenheit's
FINANCE	Represent simple interest growth scenarios using linear graphs and compound interest growth scenarios using graphs showing compound change, in order to Investigate the following scenarios: ○ loan agreements between family members where repayments are made only once at the end of the loan. ○ investments in fixed deposit accounts where the money is deposited and withdrawn from the account only once. ○ bank accounts with a changing balance

TERMINOLOGY

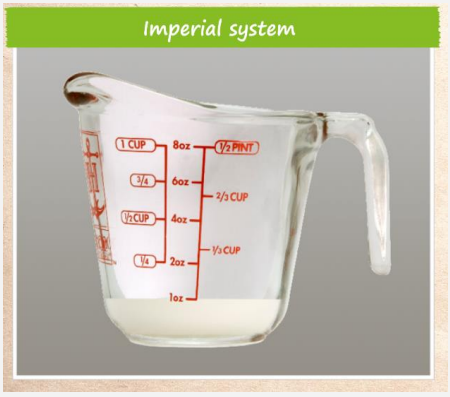
Term	Definition
Cubed	The power of three; multiplied by itself three times.
Degrees Celsius	Unit used to measure temperature in most countries.
Dimension	A measurable extent, e.g. length, breadth, height, depth, time. Physics, technical: the base units that make up a quantity, e.g. mass (kg), distance (m), time (s).
Imperial System	A system of measurement using inches, pounds, feet, gallons and miles.
Measuring	Determine the value of a quantity directly, e.g. reading the length of an object from a ruler or the mass of an object from a scale.
Metric System	A system of measurement that uses metres, litres, kilograms, etc. A measurement system, using a base of 10 (i.e., all the units are divisible by 10).

SESSION 1 | CONVERSIONS

WHAT YOU SHOULD KNOW

By the end of the lesson learners must be able to

- Convert units of length, capacity, mass and time
- Convert between SI units (International System/metric system) and imperial units
- Measure time in second, minutes, hours, days, weeks and months
- Convert between degrees Celsius to Fahrenheit's



Measurement conversions

Since accurate measurement is vital for daily use, a consistent set of units is necessary, study the tables below:

Imperial and Metric Conversions:

The SI unit (International System Unit) is the world's most used system of units for measurement.

Whilst the imperial system is used in countries like the (United Kingdom) and the (United States).

Conversion of distance

METRIC CONVERSIONS					
1 centimeter	=	10 millimeters	1 cm	=	10 mm
1 meter	=	100 centimeters	1 m	=	100 cm
1 kilometer	=	1000 meters	1 km	=	1000 m

STANDARD CONVERSIONS					
1 foot	=	12 inches	1 ft	=	12 in
1 yard	=	3 feet	1 yd	=	3 ft
1 yard	=	36 inches	1 yd	=	36 in
1 mile	=	1760 yards	1 mi	=	1760 yd

METRIC -> STANDARD CONVERSIONS					
1 millimeter	=	0.03937 inches	1 mm	=	0.03937 in
1 centimeter	=	0.39370 inches	1 cm	=	0.39370 in
1 meter	=	39.37008 inches	1 m	=	39.37008 in
1 meter	=	3.28084 feet	1 m	=	3.28084 ft
1 meter	=	1.09361 yards	1 m	=	1.09361 yd
1 kilometer	=	1093.6133 yards	1 km	=	1093.6133 yd
1 kilometer	=	0.62137 miles	1 km	=	0.62137 mi

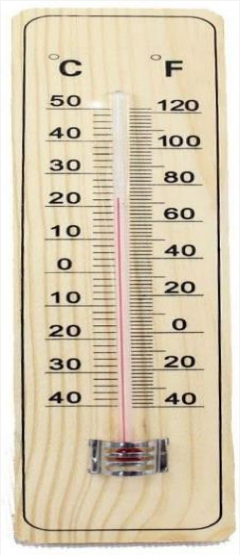
STANDARD -> METRIC CONVERSIONS					
1 inch	=	2.54 centimeters	1 in	=	2.54 cm
1 foot	=	30.48 centimeters	1 ft	=	30.48 cm
1 yard	=	91.44 centimeters	1 yd	=	91.44 cm
1 yard	=	0.9144 meters	1 yd	=	0.9144 m
1 mile	=	1609.344 meters	1 mi	=	1609.344 m
1 mile	=	1.609344 kilometers	1 mi	=	1.609344 km

Conversion of time

Conversion	Rule	Example
Days into Hour	1 day = 24 hours	7 days = 7 × 24 = 168 hours
Days and hours into hours	First, convert days into hours by multiplying number of days with 24 and then add hours into it.	7 days 9 hours = 7 days + 9 hours = (7 × 24) + 9 hours = 168 hours + 9 hours = 177 hours
Hours into Minutes	1 hour = 60 minutes	5 hours = 5 × 60 = 300 minutes
Hours and minutes into minutes	First, convert hours into minutes by multiplying number of hours with 60 and then add minutes into it.	7 hours 45 minutes = 7 hours + 45 minutes = (7 × 60) + 45 minutes = 420 + 45 = 465 minutes
Minutes into seconds	1 minute = 60 seconds	25 minutes = 60 × 25 = 1500 seconds

CONVERSIONS

Thermometer - An instrument for measuring and indicating temperature.



Conversion of Temperature

Below are two main temperature scales:

- ***°C**, the **Celsius Scale** (part of the Metric System, used in most countries)*
- ***°F**, the **Fahrenheit Scale** (used in the US), and*

They both measure the same thing, temperature!

To covert from Celsius to Fahrenheit or the other way round, we use the following given formulae

$$^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32$$

$$Or$$

$$^{\circ}\text{C} = (^{\circ}\text{F} - 32^{\circ}) \div 1.8$$

Example 1

South African Bongmusa Mthembu won the 2017 Comrade Marathon. He ran the 86.73 km ultra-marathon in a time of 5:35:34.

1.1 Convert the distance of the ultramarathon to miles

Use the factor : $1km = 0.6214$

1.2 The race started at 5:30 am. Calculate the time at which he reached the finish line.

Solutions:

1.1 $km = 0.6214$

Then $86.73\ km = 0.6214\ x\ 86.73$

$$86.73\ km = 53.894\ miles$$

$$\approx 53.89\ \text{miles}$$

1.2 **Start time** $= 5:30:00$

Finish time $= 5:35:34$

Time at the finish line $= 5:30:00 + 5:35:34$

$$= 11:05:34$$

Example 2

You find a recipe for a lemon pie on the internet.

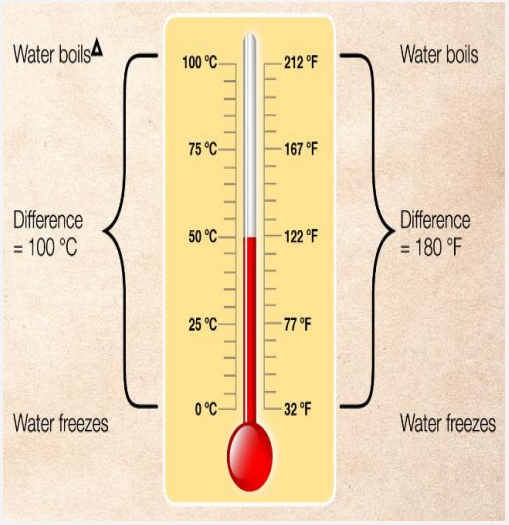
Covert the following ingredients from the imperial measures to metric measure.

2.1 2.5 teaspoons of castor sugar to ml.

2.2 0.25 cup butter to ml, round answer **to the nearest 5ml**

CONVERSIONS

Metric measurements	Imperial measurements
1 cm	0.628 inches
25.4 mm	1 inch
5 ml	1 teaspoon
250 ml	1 cup
1kg	2.2 pounds
15ml	1 tablespoon



Solutions:

2.1 $\mathbf{1\ teaspoon} = \mathbf{5}\ ml$

$\mathbf{Then\ 2.5\ teaspoons} = \mathbf{5}\ ml \times \mathbf{2.5}$

$= \mathbf{12.5}\ ml$

2.2 $\mathbf{1\ cup} = \mathbf{250}\ ml$

$\mathbf{0.25\ cup\ of\ butter} = \mathbf{250} \times \mathbf{0.25}$

$= \mathbf{62.5}$

$\mathbf{To\ the\ nearest\ 5}ml = \mathbf{65}\ ml$

Example 3

For making the lemon pie the recipe gives the baking temperature as $350°\mathrm{F}$. Convert the temperature to degrees **Celsius using the formula** $°\mathrm{C} = (°\mathrm{F} - \mathbf{32}^{\circ}) \div \mathbf{1.8}$.

Round answer to a number that makes sense in the context of baking. Assuming that the oven calibration is in 10 degrees Celsius.

Solution: $°\mathrm{C} = (°\mathrm{F} - \mathbf{32}^{\circ}) \div \mathbf{1.8}$

$= (\mathbf{350}^{\circ} - \mathbf{32}^{\circ}) \div \mathbf{1.8}$

$= \mathbf{318} \div \mathbf{1.8}$

$= \mathbf{176.666666666}$

$\approx \mathbf{180}^{\circ}$

EXERCISE

1. The highest worldwide 24-hour rainfall, 72 inches, was measured on Reunion Island. Determine the difference between the worldwide record and the highest 24-hour rainfall in South Africa, 597mm, which was measured on 31 January 1984 at St Lucia.

2. A household consist of four people. The reading on the water meter at the beginning of January was $0008945\mathrm{m}^3$. On the last day of the month it was $0008969\mathrm{m}^3$

2.1 Calculate how many liters of water was used during the month. **If 1 liter = 0.001 m^3**

2.2 Determine the average water usage in liters per person per day for January.

SESSION 1 | CONVERSIONS

Blackcurrant cheesecake

6 oz biscuits

½ teaspoon cinnamon

5 oz castor sugar

3½ oz butter

½ lb cottage cheese

½ lb full fat soft cream cheese

1 egg

2 tablespoons *créme de cassis*

½ lb drained, canned or fresh poached blackcurrents

The cake is large enough for ten people

Metric measurements	Imperial measurements
1 cm	0.628 inches
25.4 mm	1 inch
5 ml	1 teaspoon
250 ml	1 cup
1kg	2.2 pounds
15ml	1 tablespoon

3. Study the accompanying recipe and answer the questions what follows.

3.1 Which system of measurement was used in the recipe?

3.2 Calculate in grams, how much cottage cheese is required in the recipe.

3.3 Determine to the nearest whole number how many tablespoons are required to fill one cup.

3.4 The cake is baked at 180°C, at how many degrees Fahrenheit should it be baked?

SOLUTIONS

1. 1 inch = 25,4 mm
∴ 72 inch = 72 × 25,4 mm
= 1 828,8 mm

Difference = 1 828,8 – 597
= 1 231,8 mm

2.1 Water used during the Month
$= 0008969m^3 - 0008945m^3 = 00024m^3$
but $0.001m^3 = 1\ liter$
$1m^3 = \frac{1}{0.001}$
then $00024m^3 = 1000 \times 000024$
$= 24\ 000\ liters$

2.2 Average water usage per day $= \frac{24\ 000\ liters}{31\ days}$
$= 774.193.....$ liter

Average water usage per person per day
$= 193.548.....$
≈ 193.55 liter

3.1 Imperial system

3.2 ½ pond $= \frac{1}{2,2} \times 0,5$
= 0,22727 kg
≈ 227 g

3.3 $\frac{250}{15} = 16,666...$
= 17 tablespoons

3.4 $°F = (1.8 \times °C) + 32$
$= (1.8 \times 180) + 32$
$= 356\ °C$

TERMINOLOGY

Term	Definition
Interest	is the amount of money paid for the use of money borrowed
Interest rate	is the percentage of the total sum of money that is paid in interest
Interest	can be calculated per year, per month or day
Interest per day	Interest rate per year ÷ 365 (or 366 in a leap year)
Interest per month	interest rate per year ÷ 12
Per annum	is the Latin term meaning “per year” and is often abbreviated as p.a.

SESSION 2 | FANANCE - INTEREST

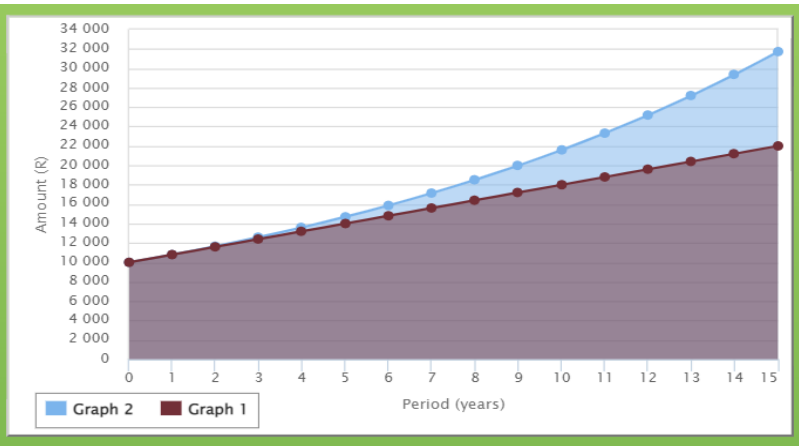
WHAT YOU SHOULD KNOW

Interest is the amount of money charged for borrowing someone else's money.

It is not free to borrow money and the different lending institutions charge different rates for various periods of lending.

Interest may also be earned by investing or saving money. Institutions also offer different rates on savings, depending on the amount and period of investment.

Simple interest vs Compound interest



Graph number	Type	Initial amount	Interest rate	Period	Compounded	Final amount
Graph 1	Simple interest	R10 000	8%	15 years	n/a	R22 000
Graph 2	Compound interest	R10 000	8%	15 years	Yearly	R31 722

Simple Interest

Example 1

Calculate the simple interest earned if R5 000 is invested at an interest rate of 12,5% for 5 years.

Solution:
Interest for 1 year:
$= \frac{12}{100} \times 5\,000$

= R600
Interest for 5 years
= R600 × 5 = R3 000

Example 2

You borrow R8 000 and have to pay it back over 18 Months with interest. If they charged you 8,5% simple interest per annum, calculate the total amount you would pay back.

Solution:
NB: Always convert months to years
i.e., 18 months = $\frac{18}{12}$ years = 1,5 years

Interest for 1 year:
$\frac{8,5}{100} \times$ R8 000 = R680

Interest for 1,5 years:
= RR680 × 1,5 = R1 020

Total to pay back:
R8 000 + R1 020 = R9 020

FANANCE - INTEREST

Example 3

You invested a sum of money that earned R750 simple interest at a simple interest rate of 10% p.a. over 3 years. Determine the amount that was invested.

Solution:

Let the amount invested be Ry

Interest for 1 year: $\frac{10}{100} \times y = R0{,}10y$

Interest for 3 years: $R0{,}10y \times 3 = R0{,}3y$

Total interest =R750

$\therefore 0{,}3y = 750$

$\therefore y = R2\ 500$

Compound interest

Calculating compound interest for a number of time intervals

Compound interest for one interval = $\frac{Interest\ rate}{100} \times$ Initial amount

Compound interest for next interval = $\frac{Interest\ rate}{100} \times$ new initial amount

Repeat this process for each interval.

The number of times this calculation must be repeated depends on how the interest is compounded.

Example 4

Invest R3 000 for a period of 1 year at a rate of 5% per year, compounded half-yearly.

Determine the final amount at the end of the investment period.

Solution:

Interest rate per half year = $\frac{5\%}{2} = 2{,}5\%$

Compound interest for one interval = $\frac{2{,}5\%}{100} \times R3\ 000$

$= R75$

Compound interest for next interval = $\frac{2{,}5\%}{100} \times R3\ 075 = R76{,}88$

Final amount = R3 075 + R 76,88

= R 3 151,88

FANANCE - INTEREST

We find interest in many everyday situations:

- Banking (saving or investing)
- Overdraft accounts
- Credit cards
- Student loans
- Home loans
- Car financing
- Buying furniture, clothing or appliances on account

Exercise

Loan agreement and repayment

1. John is in his first year of university and wants to buy a small secondhand car. His sister already has a job and agrees to loan him R20 000 which is the cost price of his car. She can put up the money immediately, but he will have to save a bit every month so that he can afford to pay back the lump sum (with interest) after 2 years. His sister says he must pay 9% p.a. simple interest.

1.1 What amount will he have to pay at the end of the 2 years?

1.2 If he wants to save an equal amount of money every month, how much must he save each month in order to pay back the loan including interest after 2 years?

1.3 How much more will John have to pay his sister if she charges him 9% compound interest, compounded yearly, over the two years?

Bank account with a changing balance

2. Joe is looking at two investment options and trying to decide which option is best. He wants to invest R6 000 in a saving account for twenty years. Joe considers the following options:

   - Option 1: Offers 12% simple interest per year.
   - Option 2: offers 10% compound interest per year.

   Joe draws up a table to determine how much he will have in his account for each option:

Year	0	1	2	3	4	5
Option 1	6000	6720	7440	8160	8800	9600
Option 2	6000	6600	7260	7986	8784,60	9663,06

2.1 Which option has the highest interest rate per annum?

2.2 Does the option with the highest interest rate give the highest2 balance after 20 years? Explain your answer.

2.3 After how many years does it start becoming more profitable to have the compound interest option?

Solutions

1.1 Amount after 2 years = amount loaned + interest
interest per year = amount loaned x 9%
= R20 000 × 0,09 = R1 800
Interest for 2 years = R1 800 × 2 = R3 600
Amount owing after 2 years = R20 000 + R3 600 = $\boldsymbol{R23\ 600}$

1.2 Monthly amount he needs to save is total amount owed, spread over 24 months.

Monthly savings needed to repay loan = $R23\ 600 \div 12$

$= R983.3333\ldots$

$\approx R983{,}33$

If John saves R983,33 each month for 2 years he will be able to repay his sister.

1.3 Interest = loan amount x interest charged

Interest 1st year $= R20\ 000 \times 0{,}09$

$= R1\ 800$

Loan amount at the end of 1st year = $R20\ 000 + R1\ 800$

$= R21\ 800$

Interest 2nd year $= R21\ 800 \times 0{,}09 = R1\ 962$

Loan amount at the end of 2nd year = $R21\ 800 + R1\ 962$

$= R23\ 762$

Monthly repayment = $R23\ 762 \div 24$

$= R990{,}08$

Difference: $R23\ 762 - R23\ 600 = R162$

He will have to pay R162 more if she charges him compound interest.

2.1 Option 1 , the simple interest option

2.2 No, Even though Joe could earn 12% simple interest per annum and only 10% compound interest per annum, he will still earn more after investing for 20 years with the compound interest option.

2.3 After 4 years